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955 L'ENFANT PLAZA NORTH, S.W. WASHINGTON, D. C. 20024

B70 03063

SUBJECT: Review of Skylab Program I/C Panel Interface Control Documents - Case 620

DATE: March 20, 1970

FROM: A. G. Weygand

ABSTRACT

This memorandum contains comments on the drafts of the following instrumentation and communications interface control documents prepared for the Skylab Program Instrumentation and Communications (I/C) Panel:

(a) ICD 50M16132, Orbital Assembly TV System Requirements.

(b) ICD 50M13146, Ancillary Equipment to Saturn Workshop, Instrumentation and Communications Interface.

The drafts of these two documents have been approved by the Marshall Space Flight Center co-secretary of the Skylab Program I/C Panel, Mr. R. M. Hargrove, and have been forwarded to the Manned Spacecraft Center co-chairman of the I/C Panel, Mr. C. M. Jackson, for comment.

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MEMORANDUM FOR FILE

A. General

The Marshall Space Flight Center (MSFC) approved drafts of the following instrumentation and communications (I/C) interface control documents (ICD's) prepared for the Skylab Program I/C Panel are reviewed in this memorandum.

(a) ICD 50M16132, Orbital Assembly TV System Requirements, February 26, 1970.

(b) ICD 50M13146, Ancillary Equipment to Saturn Workshop, Instrumentation and Communications Interface, February 26, 1970.

The ancillary equipment to the Skylab I whose I/C interfaces with Skylab I are covered in ICD 50M13146 includes the crewman's communication umbilical (CCU), the extravehicular activity/intravehicular activity (EVA/IVA) cable, and the portable color television (TV) camera/monitor/cable assembly. A copy of these two ICD's can be made available to those interested by the writer.

The stated purpose of ICD 50M16132 is to establish the functional requirements of the TV system of Skylab I and that of ICD 50M13146 is to establish the functional interfaces between the CCU and Skylab I and between the EVA/IVA cable and Skylab I as well as the functional, electrical, and mechanical interfaces between the portable color TV camera/monitor/cable assembly and Skylab I. It is the opinion of the writer that circuit impedance, frequency response, isolation, and signal level requirements are not functional requirements but are rather electrical parametric requirements. It is suggested that these requirements on the TV system of Skylab I contained in ICD 50M16132 and on the interfaces between the CCU and Skylab I and between the EVA/IVA cable and Skylab I in ICD 50M13146 be deleted or that the stated scope of these ICD's be expanded to include electrical parametric requirements as well as functional requirements. In the opinion of the writer, the electrical parametric requirements on the TV system of the OA should be deleted from ICD 50M16132 and be

included as appropriate in the following ICD's:

(a) ICD 50M13146;

(b) ICD 50M13125, Command and Service Module to Multiple Docking Adapter, Instrumentation and Communications Interface;

(c) ICD 50M13122, Multiple Docking Adapter to Airlock Module, Instrumentation and Communications Interface, and

(d) ICD 50M16131, Apollo Telescope Mount to Airlock Module, Instrumentation and Communications Interface.

Also it is recommended that the stated scope of ICD 50M13145 be expanded to include electrical parametric requirements for the communications interfaces between Skylab I and the CCU and EVA/IVA cable.

Specific comments by the writer on the content of ICD's 50M16132 and 50M13146 are presented in sections B and C, respectively. These comments are referenced to the numbered sections of the particular ICD to which they apply. These comments ignore the general question of whether or not the requirements are functional requirements.

B. Orbital Assembly TV System Requirements (ICD 50M16132)

3.1 Signal Distribution Network; Selection and Conditioning Equipment

In order to minimize the complexity of intermodule I/C interfaces, it is desirable to avoid provision of video signal conditioning at intermediate points between the source of the video signal (either the closed circuit TV system of the Apollo Telescope Mount or the portable color TV camera used in Skylab I) and the input to the premodulation processor (PMP) of the Command and Service Module (CSM). In the original proposal by the Manned Spacecraft Center (MSC) to provide transmission to the Manned Space Flight Network (MSFN) of video signals from a portable color TV camera, MSC estimated that no conditioning of the video signal output from the camera would be required with the maximum coax cable lengths (up to 150 feet) expected to be used between the camera being used in Skylab I and the PMP in the CM. This proposal assumed that the portable color TV camera used for this application would be obtained from the Apollo Program and be refurbished after use on an Apollo mission. In addition,

at the Cluster Systems Design Review, held during December, 1969, Mr. J. Atherton, MSFC/S&E-ASTR-I, indicated that signal conditioning and drive circuitry would be included with a sync adder in each of the two video selection coax switches of the Apollo Telescope Mount (ATM) closed circuit TV system for processing of that video signal selected for routing to the signal distribution network of Skylab I. Consequently, no signal conditioning equipment appears to be required with the signal selection equipment in the Multiple Docking Adapter (MDA).

3.1.1 Signal Distribution Network

3.1.1.1 ATM TV Signals

Since 92 ohm video cable will be used to route TV signals from the signal selection equipment in the MDA to the CSM as well as from the portable TV camera to the signal selection equipment in the MDA, it is suggested that the two TV signals from the ATM TV system be routed to the signal selection equipment in the MDA over 92 ohm video cables. Any impedance matching required between the 75 ohm video coax switches of the ATM TV system and the 92 ohm video cables could be provided by the signal conditioning and drive circuitry added to the ATM video coax switches.

3.1.1.3 SWS Output TV Signals

It should be noted in this section that the video signal presented at the CSM/MDA interface should be biased, nominally extending from minus 0.75 volts to plus 2.75 volts. The frequency response requirements for this signal should also be included in this section.

3.1.2 Selection and Conditioning Equipment

See the comments on section 3.1.

3.1.3 TV Input Stations

A requirement should be included to provide the capability to operate the portable TV camera within the CM and to transmit the resulting video signal to the MSFN. This capability should be provided for use during periods when the CSM is separated from Skylab I such as during CSM/SWS rendezvous as well as when the CSM is docked to Skylab I.

3.1.3.3 Bus Connections

The video bus need not connect through the TV input station located in the CM.

3.1.3.4 Station Locations

The specific locations of the TV input stations for the portable TV camera and the specific length of the umbilical cable associated with this camera should not be specified in a functional requirements document. It is suggested that Table 1 be replaced by a listing of the use and duty cycle requirements for the portable TV camera, such as to support specific experiments, to view the ATM control and display panel, etc. From these requirements, trade offs can be made between TV input station locations and the length of the TV camera umbilical. The results of these trade studies on the length of the TV camera umbilical should then be included in the ICD 50M13146. The duty cycle requirements are necessary to conduct CSM power usage and thermal control studies since transmission of TV signals from the CSM requires the use of an S-band power amplifier operating in the higher power mode.

3.2 TV Camera and Mounts

3.2.1 ATM TV Cameras

To be consistent with section 3.1.1.3, the electrical characteristics of the video signal output from the two ATM video switch/sync adders which will be routed to the signal distribution network should be included in this section. See comments on section 3.1.1.3.

3.2.2 Portable TV Camera

A note should be included in this section that the portable color TV cameras used in the Skylab Program will be refurbished (or new, as the case may be) cameras used in the CM's of the Apollo Program.

3.2.2.3 Monitor

Each of the portable color TV cameras used in the CM's of the Apollo Program was provided with a detachable black and white monitor which could be operated up to 3 feet from the camera. This monitor served as a view finder for the crewman operating and pointing the camera. If, as in the Apollo Program, the only function of the monitor provided with each camera to be used in the Skylab Program is to permit aiming, focusing, and adjustment of the camera, increasing the distance from the camera at which the monitor may operate from 3 to 12 feet does not seem justified. Since the input leads to this high input

impedance monitor will be bridged across the output leads of the TV camera, the additional cable length between the camera and the monitor may result in some degradation of the output video signal from the camera which will be eventually transmitted to the MSFN.

3.2.2.5 Environment

The portable color TV cameras used in the CM's of the Apollo Program and to the writer's knowledge also to be used in the Skylab Program have not been designed to or been tested for operation in a vacuum environment which would exist if one of these cameras were to be used external to Skylab I by crewmen performing EVA. To the writer's knowledge, there is no firm requirement now existing in the Skylab Program which dictates provision of a portable color TV camera which is capable of operation in space external to Skylab I.

3.2.2.6 Electrical Connections

See comments on section 3.1.3.4.

3.3 TV Transmission

3.3.1 CSM Transmission System Inputs

As noted in the comments on section 3.1.3, the functional requirement that the CSM shall be capable of accepting inputs to the transmission system directly through the umbilical of the portable color TV camera when used in the CM should be included in this ICD.

It was shown in MSC/SESD Document 21-117, "Wide-Band Television Test Report", dated February 4, 1969, prepared by the Lockheed Electronics Company that the bandwidth of a video signal transmitted by the S-band FM transmitter of the CSM will be limited to approximately 2 MHz by the associated FM modulator. Consequently, it appears that the video signal presented to the input to the CSM transmission system from the SWS need not have a frequency response of plus or minus 0.25dB from 0 to 4 MHz and that a lesser bandwidth requirement should suffice such as 0 to 2.5 MHz.

Additional Comments on ICD 50M16132

As indicated earlier in the comments on section 3.1.3.4, it is the opinion of the writer that the requirements for support from the portable color TV camera with the CSM

transmission system and from the ATM TV cameras with the CSM transmission system should be specified in detail so that it will be possible to determine the duty cycle of the CSM transmission system required for the transmission of video signals from Skylab I to the MSFN.

If the decision is made to include electrical parametric requirements, it is recommended that a new section be added to this ICD that would be devoted to electromagnetic compatibility requirements.

C. Ancillary Equipment to Saturn Workshop I/C Interface (ICD 50M13146)

3.0 T-Adapter to CCU Interface

3.1 Functional

3.1.1 Headset Assembly to CCU

In addition to the power line interface, the microphone line interface and earphone line interface included in the overall headset assembly to the CCU interface, there exists in the overall headset assembly to CCU interface a push-to-talk (PTT) line interface and a caution and warning system (CWS) tone line interface. These two additional functional interfaces should be specified in this ICD to the same degree as the power line, microphone line, and earphone line interfaces are specified.

3.1.3 CCU Commonality

As currently planned by MSFC, the CCU of a crewman to be used in the Skylab I will differ functionally from the CCU of that crewman to be used in the CM in one respect; namely, the CCU to be used in Skylab I will be provided with a volume control in the headset lines. The existence of this volume control is shown in Figure 1a of this ICD. It is not clear to the writer that this design difference between the two CCU's of each crewman is now acceptable to the crew. At meetings of the Audio Working Group of the Skylab I/C Panel in 1969, Mr. B. McCandless of MSC, representing the flight crew, indicated that the crew desired that the two CCU's be identical and not be provided with a volume control.

5.0 Portable TV Camera Assembly to SWS Interface

5.1 Functional

The majority of the requirements contained in this section such as power supply characteristics (voltage, current, and ripple) and TV camera output characteristics (impedance,

voltage, and bandwidth) appear to be electrical parametric requirements rather than functional requirements.

5.1.1 DC Power

The functional requirement that the portable TV camera/monitor/cable assembly shall operate from power supplied through the TV input stations from the module (MDA, AM, or OWS) in which the TV input station is located should be included in this section.

5.1.2 Video Signals

5.1.2.5 Signal Ground

A requirement to isolate the signal return (coaxial shield) of the video bus connecting the portable TV camera to the CSM/MDA interface from the structure of the Skylab I is included in ICD 50M16132 which specifies the functional requirements for the TV system of Skylab I. This requirement was presumably included in ICD 50M16132 to preclude the introduction of interference on the video signal through ground loops which would be created by grounding the signal return at places other than in the PMP of the CSM.

In this section of ICD 50M13146, it is specified that the signal return shall be grounded to the camera case. Unless the pan-tilt bracketry provided to fix mount the camera at selected locations in Skylab I and the portable camera mount attachable to the grid floor of the OWS provide electrical isolation between the camera case and the structure of Skylab I, the signal return to the portable TV camera will be effectively grounded to the structure of Skylab I at the camera end of the video bus as well as at the PMP in the CSM. This apparent conflict in requirements contained in the two ICD's should be resolved. If the camera mounting bracketry is required when used to provide electrical isolation of the camera from the Skylab I structure, this requirement should be included in this ICD.

5.3 Mechanical

5.3.1 Portable TV Camera Assembly

The length of the TV camera umbilical should be specified in this section.

Additional Comments on ICD 50M13146

Another subsection should be added to section 5.0 to cover the electromagnetic compatibility requirements on the portable TV camera assembly to Skylab I interface. If the decision is made to include electrical parametric requirements on the CCU to Skylab I and EVA/IVA cable to Skylab I interfaces in this ICD, it is recommended that a new subsection be added to that section covering each respective interface that would be devoted to electromagnetic compatibility requirements on that interface.

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2034-AGW-mbr

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